



Certification Test Report - Modification

Report Number *HRT-18002-CTR-01*

Hart InterCivic Verity Voting 2.3

Modification Certification Test Report version 1.3

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Prepared for:

Vendor Name	<i>Hart InterCivic Inc. (Hart)</i>
Vendor System	<i>Verity Voting 2.3</i>
EAC Application No.	<i>HRT-Verity-2.3</i>
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Accredited by the National Institute of Standards and Technology (NIST) National Voluntary Lab Accreditation Program (NVLAP), and accredited by the Election Assistance Commission (EAC) for VSTL status.



Revision History

Release	Author	Revisions
v1.0	M. Santos	Initial Release; submitted to EAC for approval
v1.1	M. Santos	Updates for EAC comments
v1.2	M. Santos	Updates for additional EAC comments
v1.3	M. Santos	Updated for Hardware test report listing in "Attachments"

Disclaimer

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The tests referenced in this document were performed in a controlled environment using specific systems and data sets, and results are related to the specific items tested. Actual results in other environments may vary.

Opinions and Interpretations

There are no SLI opinions or interpretations included in this report beyond the final recommendation.



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1 Introduction

SLI Compliance is submitting this test report as a summary of the certification testing efforts for the **Hart Verity Voting 2.3** system, a modified system from **Verity Voting 2.0**, as detailed in the section System Identification. The purpose of this document is to provide an overview of the certification testing effort and the findings of the testing effort for the **Hart Verity Voting 2.3** system.

This effort included documentation review of the Technical Data Package, source code review, and testing of the **Hart Verity Voting 2.3** voting system. Testing consisted of the development of a test plan, managing system configurations, hardware testing, component and system level tests prepared by SLI, and analysis of results. The review and testing was performed at SLI's Denver, Colorado facility.

1.1 References

1. Election Assistance Commission Voluntary Voting System Guidelines version 1.0 (EAC VVSG 1.0), Volumes I & II
2. NIST NVLAP Handbook 150: 2016
3. NIST NVLAP Handbook 150-22: 2008
4. EAC Voting System Testing and Certification Program Manual, United States Election Assistance Commission, v 2.0, May 2015
5. EAC Voting System Test Laboratory Program Manual, United States Election Assistance Commission, v 2.0, May 2015
6. SLI VSTL Quality System Manual, v 2.6, prepared by SLI, March 28, 2018

1.2 Document Overview

This document contains:

- The "Introduction", which discusses the applications tested/reviewed.
- The "Certification Test Background", which discusses the testing process.
- The "System Identification", which identifies hardware and software for the **Hart Verity Voting 2.3** system.
- The "System Overview", which discusses the functionality of **Hart Verity Voting 2.3** system software and firmware.
- The "Certification Tests Results and Summary", which is a summary of the testing effort.
- The "Recommendations" section, which contains the final analysis of the testing effort.
- Attachments as follows:
 - Attachment A – Warrant of Change Control for Verity Voting 2.3
 - Attachment B - Attestation of Durability for Verity Voting 2.3
 - Attachment C - Attestation of Integrity for Verity Voting 2.3
 - Attachment D - Attestation of Production Hardware and Software for Verity Voting 2.3
 - Attachment E1 - Record of Trusted Build for Verity Voting 2.3.1



- Attachment E2 - Record of Trusted Build for Verity Voting 2.3.2
- Attachment F - Modification of Certified System Analysis Summary Verity 2.3
- Attachment G – As Run Hart Verity 2.3 EAC Modification Test Plan v1.1
- Attachment G1 - As Run Hart Verity 2.3 EAC Electrical Hardware Test Plan v2.0
- Attachment G2 – As Run Hart Verity 2.3 EAC Environmental Hardware Test Plan v2.0
- Attachment H1 - HRT_C#_MSAllInOneStandard_SCRF
- Attachment H2 - HRT_C_&_C++_MSAllInOneStandard_SCRF
- Attachment I – List of Source Code Reviewed and Results
- Attachment J – Verity Voting 2.0 to 2.3 System Modifications
- Attachment K1 - Immunity Testing for Verity Scan, Controller and TW Duo Rev 1
- Attachment K2 - Immunity Testing for Verity Scan Rev 1
- Attachment K3 -Radiated and Conducted Emissions for Verity Controller and TW Duo Rev 1
- Attachment K4 -Radiated and Conducted Emissions for Verity Scan Rev 1
- Attachment L - Hart Verity 2.3 EAC Environmental Hardware Test Report

2 Certification Test Background

This section provides a brief overview of the EAC Certification Program and the activities involved in order for a voting system to be considered for certification against the VVSG 1.0 and the current EAC program manuals.

2.1 PCA - Document and Source Code Reviews

The Physical Configuration Audit (PCA) review of the **Hart Verity Voting 2.3** documentation, submitted in the requisite Technical Data Package (TDP), was performed in order to verify conformance with the VVSG 1.0. Source code was reviewed for each software and firmware application declared within the **Verity Voting 2.3** voting system. As this is a modification test campaign, the source code was compared against the final code base of **Verity Voting 2.0**, and changes were subject to review.

All PCA reviews were conducted in accordance with *Volume II Section 2* of the VVSG 1.0, to demonstrate that the system meets the requirements. Results of the PCA documentation review can be found in section 5.2 of this Certification Test Report.

All PCA source code reviews were conducted in accordance with *Volume I Section 5.2 and Volume II Section 5* of the VVSG 1.0, to demonstrate that the system meets the requirements. Results of the PCA source code reviews can be found in *Attachment I – List of Source Code Reviewed and Results*. Inconsistencies or errors in the source code were identified to Hart for resolution or comment. Additional details of the source code review criteria can be found in *Attachments H1-H2*.



2.2 FCA - Functional & System Testing and Sampling

The Functional Configuration Audit (FCA) review of the test documentation submitted by Hart in the TDP was reviewed in order to verify testing of the voting system.

SLI's standard Test Suites were customized for the **Hart Verity Voting 2.3** voting system and conducted in accordance with *Volume II Section 6 of the VVSG 1.0*. Simulations of elections were conducted to demonstrate a beginning-to-end business use case process for the **Hart Verity Voting 2.3** voting system.

2.2.1 Test Methods

All test methods employed are within the scope of SLI's VSTL accreditation.

The following validated test methods were employed during this test campaign:

Table 1 – Test Methods

SLI VSTL Test Method Name
TM_Accuracy v1.2
TM_Basic_Election_Components v1.1
TM_Ballot Formatting and Production v1.1
TM_Error Message and Recovery v1.3
TM_HW Integrity v1.2
TM_Maintainability v1.1
TM_Readiness v1.1
TM_Tally_and_Reporting v1.1
TM_Security Access Control v1.1
TM_Security Physical Security Measures v1.1
TM_Security Software v1.1
TM_Security Telecommunications and Data Transmission v1.2
TM_Stress v1.1
TM_System Audit v1.1
TM_Telecommunications v1.1
TM_Volume v1.1
TM_Voting Capabilities v1.3
TM_Voting Straight Party v1.2

The above listed test methods are implemented in a complementary fashion: modules are employed from various methods to form suites. Suites included the logical sequence of functionality that was used to validate the requirements addressed by each module within the suite. Please see Table 3 - Terms and Abbreviations below for additional information about Test Modules and Test Suites.



- **Deviations from, to, or exclusions from the test methods**

The test methods listed in Table 1 above, contain the requirements listed in section 4.6 below. The established and validated test methods did not have any deviations. Test cases utilizing those methods were selected and grouped into test suites to validate the requirements in section 4.6.

2.2.2 Terms and Abbreviations

This section details pertinent terms applicable within this report.

Table 2 – Terms and Abbreviations

Term	Abbreviation	Description
Ballot Marking Device	BMD	An accessible computer-based voting system that produces a marked paper ballot that is the result of voter interaction with visual or audio prompts.
Cast Vote Record	CVR	Record of all selections made by a single voter whether in electronic or paper. Also referred to as a ballot image when used to refer to electronic ballots.
Central Count Scanner	CCS	High Speed Digital Scanner is a ballot scanning device typically located at a central count facility and is operated by an automated multi-sheet feeding capability.
Chevron (Arrows at top of current screen)	No Abbreviation	Verity software applications are organized around easy-to-follow workflows, with specific activities associated with “chevrons” or “arrows” in the application user interface.
Compact Flash card	CF	This is a type of flash memory card in a standardized enclosure often used in voting systems to store ballot and/or vote results data.
Compact Flash AST	CFAST	A compact flash media based on the Serial ATA bus rather than the Parallel ATA bus, used by the original Compact Flash.
Commercial Off the Shelf	COTS	Commercial, readily available hardware devices (such as card readers, printers or personal computers) or software products (such as operating systems, programming language compilers, or database management systems).
Election Assistance Commission	EAC	An independent, bipartisan commission created by the Help America Vote Act (HAVA) of 2002 that operates the federal government's voting system certification program.



Term	Abbreviation	Description
Election Management System	EMS	Typically utilizes a database management system to enter jurisdiction information (district, precincts, languages, etc.) as well as election specific information (races, candidates, voter groups (parties), etc.). In addition, the EMS is also used to lay out the ballots, download the election data to the voting devices, upload the results and produce the final results reports.
Electromagnetic Compatibility	EMC	The goal of EMC is to validate the correct functioning of different equipment in the same environment and the avoidance of any interference effects between them.
Functional Configuration Audit	FCA	Exhaustive verification of every system function and combination of functions cited in the vendor's documentation. The FCA verifies the accuracy and completeness of the system's Voter Manual, Operations Procedures, Maintenance Procedures, and Diagnostic Testing Procedures.
National Institute of Standards and Technology	NIST	A non-regulatory federal agency within the U.S. Dept. of Commerce. Its mission is to promote U.S. innovation and industrial competitiveness by advancing measurement science, standards, and technology in ways that enhance economic security and improve our quality of life.
National Voluntary Laboratory Accreditation Program	NVLAP	A division of NIST that provides third-party accreditation to testing and calibration laboratories.
Physical Configuration Audit	PCA	The testing activities associated with the physical aspects of the system (hardware, documentation, builds, source code, etc.).
Primary – Closed	No Abbreviation	The Closed Primary election segregates each political party onto its own ballot, along with all pertinent non-political contests and referendums.
Primary - Open	No Abbreviation	The Open Primary election combines all political parties' contests onto a single ballot, along with all pertinent non-political contests and referendums.
Precinct Count Scanner	PCS	A precinct-count optical scanner is a mark sense-based ballot and vote counting device located at a precinct and is typically operated by scanning one ballot at a time.
Request For Information	RFI	A form used by testing laboratories to request, from the EAC, interpretation of a technical issue related to testing of voting systems.



Term	Abbreviation	Description
Requirements Matrix	N/A	This is the matrix created by the EAC and maintained by SLI that traces the requirements to the various test modules and test methods.
Standard Lab Procedure	SLP	SLI's quality system documentation is made up of standard lab procedures (SLPs), which are procedures required to ensure a systematic, repeatable and accurate approach to voting systems testing and governing the actual performance of SLI's work.
(Verity) Tab	No Abbreviation	Verity software applications are organized around easy-to-follow workflows and activities; a "Tab" provides specific activities associated with "chevron" workflows in the application user interface.
Voting Center	No Abbreviation	Typically, a convenient voting location that manages multiple ballot styles.
Technical Data Package	TDP	This is the data package that is supplied by the vendor and includes: Functional Requirements, Specifications, End-user documentation, Procedures, System Overview, Configuration Management Plan, Quality Assurance Program, and manuals for each of the required hardware, software, firmware components of each voting system.
Test Method	No Abbreviation	SLI proprietary documents which are designed to group sets of EAC VVSG requirements in a logical manner that can be utilized to efficiently validate where and how requirements, or portions of a requirement, are met.
Test Module	No Abbreviation	An actionable component of a Test Method, that functionally verifies that a requirement is met within a voting system. Test Modules are at a generic level within the Test Method, and are customized for a particular voting system, within a Test Suite.
Test Suite	No Abbreviation	An actionable grouping of test modules designed to test a set of functions of a voting system or component in a specific way.
Validation	No Abbreviation	Confirmation by examination and through provision of objective evidence that the requirements for a specific intended use or application have been fulfilled (ISO 9000).
Verification	No Abbreviation	Confirmation by examination and through provision of objective evidence that specified requirements have been fulfilled (ISO 9000).



Term	Abbreviation	Description
Voluntary Voting Systems Guidelines Volumes I & II	VVSG	A set of specifications and requirements against which voting systems can be tested to determine if the systems provide all of the basic functionality, accessibility and security capabilities required of these systems.
Voting System Test Lab	VSTL	The accredited lab where the voting system is being tested.
Voting System Under Test	VSUT	The designation for a voting system that is currently being tested.
Voting Test Specialist	VTS	An SLI Compliance employee who has been qualified to perform EAC voting system certification testing.

3 System Overview

3.1 Scope of the Hart Verity Voting 2.3 Voting System

This section provides a description of the scope of **Hart Verity Voting 2.3** voting system components:

- The **Hart Verity Voting 2.3** voting system represents a set of software applications for pre-voting, voting and post-voting election project activities for jurisdictions of various sizes and political division complexities. **Verity Voting 2.3** functions include:
 - Defining the political divisioning of the jurisdiction and organizing the election with its hierarchical structure, attributes and associations.
 - Defining the election events with their attributes such as the election name, date and type, as well as contests, candidates, referendum questions, voting locations and their attributes.
 - Preparing and producing ballots for polling place and absentee voting or by-mail voting.
 - Preparing media for precinct voting devices and central count devices.
 - Configuring and programming the **Verity Scan** digital scanners for marked paper ballots and Verity Touch Writer printed vote records..
 - Configuring and programming the **Verity Touch Writer** BMD devices.
 - Configuring and programming the **Verity Controller** with **Verity Touch Writer Duo** BMD devices.
 - Configuring and programming the **Verity Controller** with **Verity Touch** and **Touch Writer Duo** DRE devices.
 - Configuring and programming the **Verity Print** on-demand ballot production device.
 - Producing the election definition and auditing reports.



- Providing administrative management functions for user, database, networking and system management.
 - Import of the Cast Vote Records from **Verity Scan** devices and **Verity Central**.
 - Preview and validation of the election results.
 - Producing election results tally according to voting variations and election system rules.
 - Producing a variety of reports of the election results in the desired format.
 - Publishing of the official election results. Auditing of election results including ballot images and log files.
- **Verity Scan** is a digital scan precinct ballot counter (tabulator) that is used in conjunction with an external ballot box. The unit is designed to scan marked paper ballots or Verity Touch Writer Duo printed vote records, interpret and record voter marks on the marked paper ballot or record voter selections on the printed vote records, and deposit into the secure ballot box.
 - The **Verity Touch Writer** is a standalone precinct level Ballot Marking Device (BMD) which also includes an Audio Tactile Interface (ATI), which allows voters who cannot complete a paper ballot to generate a machine-readable and human readable paper ballot, based on vote selections made, using the ATI.
 - The **Verity Touch Writer Duo** is a daisy chained configuration of a **Verity Controller** device configured with up to twelve **Verity Touch Writer Duo** BMD devices, which allows voters to utilize the touchscreen or optional Audio Tactile Interface to generate a machine-readable and human readable printed vote record, based on vote selections made.
 - The **Verity Touch** is a Direct Recording Electronic (DRE) device chained configuration of a **Verity Controller** device configured with up to twelve **Verity Touch** devices, which allows voters to cast their vote electronically via a touchscreen.
 - The **Verity Touch with Access** is a DRE device chained configuration of a **Verity Controller** device configured with up to twelve **Verity Touch** or **Touch with Access** devices, which allows voters to cast their vote electronically via a touchscreen or Audio Tactile Interface (ATI).
 - **Verity Print** is an on-demand ballot production device for unmarked paper ballots.
 - **Verity Election Management** allows users with the Administrator role to import and manage election definitions. Imported election definitions are available through the Elections chevron in Build. Users can also delete, archive, and manage the election definitions.
 - **Verity User Manager** enables users with the correct role and permissions to create and manage user accounts within the **Verity Voting** system for the local workstation in a standalone configuration, or for the network in a networked configuration.
 - **Verity Desktop** enables users, with the correct roles, to set the workstations' date and time, gather **Verity** application hash codes (in order to validate the correctness of the installed applications), and access to Windows desktop.
 - **Verity Data** provides the user with controls for entering and proofing data and audio. **Verity Data** also performs validation on the exported information to ensure that it will successfully import into **Verity Build**.



- **Verity Build** opens the election to proof data, view reports, and print ballots, and allows for configuring and programming the **Verity Scan** digital scanners, and **Verity Touch Writer** and **Controller/Touch Writer Duo** BMD devices, **Verity Print**, **Verity Controller/Touch** series devices, as well as producing the election definition and auditing reports.
- **Verity Central** is a high-speed, central digital ballot scanning system used for high-volume processing of ballots (such as vote by mail). The unit is based on COTS scanning hardware coupled with custom **Hart**-developed ballot processing application software which resides on an attached work-station.
- **Verity Count** is an application that tabulates election results and generates reports. **Verity Count** can be used to collect and store all election logs from every **Verity** component/device used in the election, allowing for complete election audit log reviews.

3.1.1 Supported Languages

The **Hart Verity Voting 2.3** voting system supports English, Spanish, Chinese, Japanese, Korean, Khmer, Thai, Vietnamese, Tagalog, Ilocano, Hindi.

3.2 Changes from Verity 2.0 to Verity 2.3

3.2.1 Modifications new to Verity 2.3

Verity Voting 2.3 is a modification of the EAC-certified **Verity Voting 2.0** system.

The modifications to **Verity 2.3** address multiple facets of the system, including state specific features, new features for **Verity Scan**, **Verity Touch Writer**, **Verity Controller**, **Verity Touch**, **Verity Touch with Access**, **Verity Data**, **Verity Build**, **Verity Central**, **Verity Count**, **Verity User**, **Verity Desktop**, as well as associated documentation updates. **Touch Writer Duo** is a newly introduced ballot mark device based off of **Touch Writer** with an output of a print vote record rather than a marked ballot. Specific details on all implemented modifications can be found in Attachment J – Verity Voting 2.0 to 2.3 System Modifications.



- Verity Print is a ballot production device that provides unmarked printed ballots.
- Verity Touch Writer and Scan may be installed in polling places to support paper-based voting.
- Verity Controller, Touch Writer Duo, and Scan may be installed in polling places to support paper-based voting.
- Verity Controller and Touch may be installed in polling places to support DRE voting.
- Verity Key (not shown) is required for user access into components to load election elections, to use critical features, and to generate reports. Feature access depends on the roles applied to user accounts.
- vDrive Duplicator (not shown) is an optional device, used for populating multiple vDrives simultaneously.

4.2 Documentation

The TDP documentation listed below are deliverables of the certified system delivered as part of the examined system, as follows:

Document Title	Version
All-In-One Code Framework Coding Standards	© 2014 Microsoft Corporation
Verity Voting 2.3 Change Notes: Update from 2.0 to 2.3.0	A.00
Verity Voting 2.3 Change Notes: Update from 2.3.0 to 2.3.1	A.00
Verity Voting 2.3 Change Notes: Verity Controller Update from 2.3.1 to 2.3.2	A.00
Configuration Management Process	D.01
Continual Improvement Process	E.02
Control of Nonconforming Product Procedure	B.02
DEVICE CONFIGURATION PROCESS DOCUMENT	B.00
DEVICE OS CREATION AND CONFIGURATION PROCESS DOCUMENT	A.01
DEVICE WES7 CREATION PROCESS DOCUMENT	A.01
Document Control Procedure	E.05
Factory TUV SUD inspection 2018 June report	N/A
Hardware 2005713-CFAST Door Security Kit Design.pdf	B
Hardware 3005018-ATI Kit Design.pdf	A



Hardware 3005174-AutoBallot Kit Design.pdf	B
Hardware 3005350-Scan Design.pdf	H
Hardware 3005351-Controller Design.pdf	D
Hardware 3005352-Touch Writer Design.pdf	G
Hardware 3005353-Touch with Access Design.pdf	E
Hardware 3005355-Touch Design.pdf	D
Hardware 3005356-Print Design.pdf	D
Hardware 3005357-Ballot Box Design.pdf	D
Hardware 3005358-Standard Booth Design.pdf	C
Hardware 3005359-Accessible Booth Design.pdf	D
Hardware 3005700-Touch Writer Duo Design.pdf	A
Hardware 3005800-Scan Design.pdf	A
Hardware 3005801-Accessible Booth With ATI Tray Design.pdf	A
Hardware 3005825-Controller Design.pdf	A
Hardware Design and Development Procedure	D.01
Hardware PCB Photos	N/A
Hardware Verification and Validation Process	D.01
Hart NRTL Safety Certificate U8 17 10 90917 004	N/A
Hart Secure Ballot Stock Specification	A.01
Verity 2.3 Test Cases	N/A
Verity Voting 2.3 Notice of Protected Information	A.00
Quality Manual	D.04
Records Retention Matrix	E.02
Software Design and Development Procedure	D.02
Software Production Procedure	E.01
Software Test Design and Development Procedure	D.02
Software Verification and Validation Process	D.02
Software Versioning Procedure	C.04
Hart Requirements Management Requirements Management Process	A.02



Supplier Qualification and Management Procedure	C.02
THE VERITY ACCESS FIRMWARE BUILD PROCEDURE	A.01
THE VERITY MCU FIRMWARE BUILD PROCEDURE	A.02
THE CREATION AND CONFIGURATION OF THE TRUSTED BUILD ENVIRONMENT	A.03
Verity Voting 2.3 TDP Abstract	A.01
Verity 2.3 VVSG 1.0 TDP Trace	N/A
Verity 2.3.X COTS List	N/A
Airgap Interface for Portable Electronic Media Technical Reference	A.02
Verity Application Framework Technical Requirements Document (TRD)	A.00
THE VERITY APPLICATION BUILD PROCESS FOR VERITY 2.3.1	A.01
Verity Application Programming Interface Specification Technical Document	A.04
Verity Ballot Creation Technical Requirements Document (TRD)	A.00
Verity Base Station Microcontroller Specification	A.01
Verity Build Technical Requirements Document (TRD)	A.00
Verity Central Technical Requirements Document (TRD)	A.00
Verity Coding Standard Standards Document	A.14
Verity Controller Technical Requirements Document (TRD)	A.01
Verity Count Technical Requirements Document (TRD)	A.01
Verity Data Technical Requirements Document (TRD)	A.00
Verity Database Attributes	C.02
Verity Device Suite Technical Requirements Document (TRD)	A.00
Verity Election Definition Data Technical Requirements Document (TRD)	A.01
Verity Election Management Technical Requirements Document (TRD)	A.00
Verity System Design Verity Electronics Specification	A.15
Verity Entity Relationship Diagram Database - Devices	N/A



Verity Entity Relationship Diagram Database - Servers (Count Only)	N/A
Verity Entity Relationship Diagram Database - Servers (No Count)	N/A
Verity Key Design Technical Document	A.02
Verity Logging Design Technical Document	1.03
Verity Logging Technical Requirements Document (TRD)	A.00
Verity Voting Verity Operational Environment	C.05
PC Application Framework UI Design Document	5
Verity Voting Performance Characteristics	C.02
Verity Print Technical Requirements Document (TRD)	A.00
Verity Risk Assessment	B.01
Verity Scan Technical Requirements Document (TRD)	A.00
Verity Security Requirements Document	A.07
Verity Shared Device User Interface Design Document	7
Verity Software Architecture-Design 4005463 B01	B.01
Usability Test Report of Verity Touch/Touch Writer and Verity Scan	N/A
Verity Voting Summative Usability Test Plan	A.01
Verity – Supply Chain PRD Supply Chain / Operations / Services Planning Document	C.01
Verity Voting 2.3 System Limits	C.01
Verity Touch Technical Requirements Document (TRD)	A.00
Verity Touch Writer Duo Base Station Microcontroller Specification	A.00
Touch Writer Duo Technical Requirements Document (TRD)	A.00
Verity Touch Writer Technical Requirements Document (TRD)	A.00
Verity User Management Technical Requirements Document (TRD)	A.00
Verity Vote Counting and Cast Vote Records Technical Requirements Document (TRD)	A.00
Verity Voting 2.3 Implementation Statement	A.00



Application for Certification – Verity Voting 2.3 Usability Impact Statement	N/A
Verity Voting 2.3.1, 2.3.2 Source Documentation.zip	N/A
Verity Voting National Certification Test Specification	B.02
Verity Workstation Manufacturing Process Document	B.01
Administrator’s Guide VERSION 2.3 (Build)	A.01
Administrator’s Guide VERSION 2.3 (Central)	A.02
Administrator’s Guide VERSION 2.3 (Count)	A.03
Administrator’s Guide VERSION 2.3 (Data)	A.02
Device Troubleshooting Field Guide VERSION 2.3	A.03
Polling Place Field Guide VERSION 2.3 (CDS)	A.02
Polling Place Field Guide VERSION 2.3 (CT)	A.02
Polling Place Field Guide VERSION 2.3 (SW)	A.01
Support Procedures Guide VERSION 2.3	A.03
System Administrator’s Guide VERSION 2.3	A.02
Verity Print Field Guide VERSION 2.3	A.01
VIRTEX ENTERPRISES LP QUALITY SYSTEM MANUAL	R
Voting System Implementation And Maintenance Process Document	C.02
VSTL Product Submission Procedure	D.02
Verity 2.3 Workstation Configuration Process Document	A.01
WORKSTATION WES7 CREATION PROCESS DOCUMENT	A.00

4.3 Software and Firmware

Any and all software/firmware that is to be used by the declared voting system whether directly or indirectly, in a production environment, must be validated during the certification process.

The software and firmware employed by **Hart Verity Voting 2.3** consists of 2 types, custom and commercial off the shelf (COTS). COTS applications were verified to be pristine, or were subjected to source code review for analysis of any modifications and verification of meeting the pertinent standards. The COTS software and firmware was either obtained directly from the 3rd party manufacturer, or was verified against digital signatures obtained from the 3rd party manufacturer. No modified COTS were implemented.

Tables 3 and 4 below detail each application employed by the **Hart Verity Voting 2.3** voting system.



Table 3 – Hart Verity Voting 2.3 Custom Software and Firmware

Application	Version
Verity Data	2.3.1
Verity Build	2.3.1
Verity Central	2.3.1
Verity Count	2.3.1
Verity Print	2.3.1
Verity Scan	2.3.1
Verity Touch Writer	2.3.1
Verity Touch Writer Duo	2.3.1
Verity Controller	2.3.2
Verity Touch	2.3.1
Verity Touch with Access	2.3.1

Table 4 – COTS Software

Verity Data/Build	
Description	Version
Microsoft Windows Embedded Standard 7, Service Pack 1	6.1.7601
Microsoft SQL Server 2012 for Embedded Systems License	11.00.2100
McAfee Application Control for Devices	6.1.1.369
Verity Central	
Microsoft Windows Embedded Standard 7, Service Pack 1	6.1.7601
Microsoft SQL Server 2012 for Embedded Systems License	11.00.2100
McAfee Application Control for Devices	6.1.1.369
Verity Count	
Microsoft Windows Embedded Standard 7, Service Pack 1	6.1.7601
Microsoft SQL Server 2012 for Embedded Systems License	11.00.2100
McAfee Application Control for Devices	6.1.1.369
Verity Print	
Microsoft Windows Embedded Standard 7, Service Pack 1	6.1.7601



Microsoft SQL Server 2012 Express License	11.00.2100
McAfee Application Control for Devices	6.1.1.369
Verity Scan – Paper Ballot Scanner	
Microsoft Windows Embedded Standard 7, Service Pack 1	6.1.7601
Microsoft SQL Server 2012 Express License	11.00.2100
McAfee Application Control for Devices	6.1.1.369
Nuance Western OCR, Desktop, OEM	V20
Verity Touch Writer – Electronic BMD Device	
Microsoft Windows Embedded Standard 7, Service Pack 1	6.1.7601
Microsoft SQL Server 2012 Express License	11.00.2100
McAfee Application Control for Devices	6.1.1.369
Verity Touch Writer Duo – Electronic BMD Device	
Microsoft Windows Embedded Standard 7, Service Pack 1	6.1.7601
Microsoft SQL Server 2012 Express License	11.00.2100
McAfee Application Control for Devices	6.1.1.369
Verity Controller – Networked Centralized Management Device	
Microsoft Windows Embedded Standard 7, Service Pack 1	6.1.7601
Microsoft SQL Server 2012 Express License	11.00.2100
McAfee Application Control for Devices	6.1.1.369
Verity Touch - Electronic DRE Device	
Microsoft Windows Embedded Standard 7, Service Pack 1	6.1.7601
Microsoft SQL Server 2012 Express License	11.00.2100
McAfee Application Control for Devices	6.1.1.369
Verity Touch with Access - Electronic DRE Device	
Microsoft Windows Embedded Standard 7, Service Pack 1	6.1.7601
Microsoft SQL Server 2012 Express License	11.00.2100
McAfee Application Control for Devices	6.1.1.369



4.4 Equipment (Hardware)

The hardware employed by **Hart Verity Voting 2.3** consists of 2 types, custom and commercial off the shelf (COTS). COTS hardware was verified to be unmodified, or was subjected to review for analysis of any modifications and verification of meeting the pertinent standards.

Tables 5 and 6 below detail each device employed by the **Hart Verity Voting 2.3** voting system.

Table 5 – Hart Verity Voting 2.3 Custom Voting Equipment

Description	Version
Verity Print – Ballot Printer	3005356 Rev D
Verity Scan – Paper Ballot Scanner	3005350 Rev H
Verity Scan – Paper Ballot Scanner – Update for scanner mechanism and tablet electronics obsolescence.	3005800 Rev A
Verity Touch Writer – Electronic BMD Device	3005352 Rev G
Verity Touch Writer Duo – Electronic BMD Device	3005700 Rev A
Verity Controller – Networked Centralized Management Device	3005351 Rev D
Verity Controller – Networked Centralized Management Device – Update for tablet electronics obsolescence.	3005825 Rev A
Verity Touch - Electronic DRE Device	3005355 Rev D
Verity Touch with Access - Electronic DRE Device	3005353 Rev E

Table 6 – Hart Verity Voting 2.3 COTS Equipment

Verity Data/Build	
Description	Version
Verity Central Applications and Workstation Kit <ul style="list-style-type: none"> • HP Z240 Workstation • HPZ230 Workstation supported for existing customers only • Verity Central Software (see below) 	C
Canon DR G1100 High-Speed Scanner	M111181
Canon DR G1130 High-Speed Scanner	M111171
OKI Data B432dn Mono Printer Report printer	N22500A
OKI Data B431d Mono Printer for existing customers only Report printer	N22202A



8-port Ethernet Switch	1405-8GV3
Vinpower Digital USB Duplicator 7-targets	USBShark-7T-BK
Vinpower Digital USB Duplicator 23-targets	USBShark-23T-BK
Verity Central	
Verity Central Applications and Workstation Kit <ul style="list-style-type: none"> • HP Z240 Workstation • HPZ230 Workstation supported for existing customers only • Verity Central Software (see below) 	C
Canon DR G1100 High-Speed Scanner	M111181
Canon DR G1130 High-Speed Scanner	M111171
OKI Data B432dn Mono Printer Report printer	N22500A
OKI Data B431d Mono Printer for existing customers only Report printer	N22202A
8-port Ethernet Switch	1405-8GV3
Verity Count	
Verity Count Applications and Workstation Kit <ul style="list-style-type: none"> • HP Z240 Workstation or HP Z230 Workstation • HPZ230 Workstation supported for existing customers only • Verity Count Software (see below) 	C
OKI Data B432dn Mono Report printer	N22500A
OKI Data B431d Mono Report Printer for existing customers only.	N22202A
8-port Ethernet Switch	1405-8GV3
Verity Print	
OKI Data C831dn Color Printer	N35100A
OKI Data B432dn Mono Blank Ballot Printer	N22500A
OKI Data B431d Mono Printer for existing customers only	N22202A
Verity Scan – Paper Ballot Scanner	
Verity Ballot Box	B
Verity Touch Writer – Electronic BMD Device	
OKI Data B432dn Mono Marked Ballot Printer	N22500A
OKI Data B431d Mono Printer for existing customers only Report printer	N22202A



Accessible Voting Booth	D
Verity Touch Writer Duo – Electronic BMD Device	
Brother PJ700 Series Thermal Printer	PJ723
Accessible Voting Booth	D
Standard Voting Booth	D
Verity Touch - Electronic DRE Device	
Standard Voting Booth	D
Verity Touch with Access - Electronic DRE Device	
Accessible Voting Booth	D

4.5 Test Materials

The following test materials are required for the performance of testing including, as applicable, test ballot layout and generation materials, test ballot sheets, and any other materials used in testing.

- Ballots & Blank Ballot grade paper
- Thumb Drives
- USB Dongle
- Ballot marking pens
- Printer paper rolls

4.6 Requirements

4.6.1 VVSG Requirements

The **Verity Voting 2.3** modifications were tested to applicable 2005 VVSG 1.0 requirements. This section details the requirements reviewed for **Verity Voting 2.3**.

The **Verity Voting 2.3** modification will be tested to the 2005 VVSG 1.0 requirements listed below:

Volume I:

- 2.1.2.a,b,c Accuracy
- 2.1.7.1.c Functions
- 2.2.1.2.b Ballot Formatting
- 2.2.2.d Election Programming
- 2.2.4.a-e Readiness Testing
- 2.3.3.1.c,d Common Requirements
- 2.3.3.2.b,e,h Paper based System Requirements
- 2.3.3.3.c,d,e,h,j,k.o DRE System Requirements
- 4.1.5.2 Ballot Reading Accuracy



Volume II

- 3.2.3 Testing to Reflect Additional Capabilities
- 3.2.4 Testing to Reflect Previously Tested Capabilities
- 6.2.2 System Baseline for Testing
- 6.2.3 Testing Volume

4.6.2 Hardware Requirements

Volume I:

- 2.1.4 (b,c,d) Integrity
- 4.1.2.5-12 Environmental Requirements
- 4.1.7.1 Removable Storage Media
- 4.3.3 Reliability

Volume II:

- 4.6.2-6 Non-operating Environmental
- 4.7.1&3 Environmental Tests, Operating
- 4.8 Other Environmental Tests

4.7 Hart State Specific Modification Requirements

The modifications addressed represent Hart internally developed features designed to satisfy these jurisdictional requests.

Pertinent Hart requirements are listed in Attachment J – Verity Voting 2.0 to 2.3 System Modifications.

5 Certification Test Results Summary

5.1 Source Code Review Summary

SLI reviewed the software source code for each application in the **Hart Verity Voting 2.3** voting system to determine the code's compliance with Volume I Sections 5, 9 and Volume II Section 5.4 of the VVSG 1.0 and for compliance with **Hart's** internally developed coding standards. **Verity Voting 2.3** is implemented with the C, C++ and C# languages. Results of the source code review are detailed in *Attachment I – List of Source Code Reviewed and Results*.

5.1.1 Evaluation of Source Code

The source code was reviewed for compliance per the guidelines defined in *Volume II, Section 5.4* of the VVSG 1.0. As a modification project, the **Verity Voting 2.3** code base was reviewed using the final **Verity Voting 2.0** code base as the baseline, to which the initial **Verity Voting 2.3** code base was compared. The differences found between those



two code bases served as the starting point of the code review. The source code was found to be in compliance with the terms of the VVSG 1.0, and Hart declared industry standards.

5.2 Technical Data Package Review Summary

SLI reviewed the **Hart Verity Voting 2.3** TDP, as detailed in sections 3.1 and 3.4, for compliance according to *Volume II Section 2* of the VVSG 1.0.

The review was conducted for the required content and format of:

- **System Change Notes:** Changes to certified system **Verity Voting 2.3**.
- **System Test and Verification Specifications:** Development and certification test specifications that **Hart** applied to their testing efforts. **Verity Voting 2.3**
- **Application Usability Impact statement:** Updated for **Verity Voting 2.3**
- **Performance Characteristics:** Updated for **Verity Voting 2.3**
- **System Description:** Updated for **Verity Voting 2.3**
- **Verity System Limits:** Updated for **Verity Voting 2.3**
- **Verity Operational Environment:** Updated for **Verity Voting 2.3**
- **Verity COTS List:** Updated for **Verity Voting 2.3**
- **Verity Data Technical Reference:** Updated for **Verity Voting 2.3**.
- **Verity Build Technical Reference Manual:** Updated for **Verity Voting 2.3**
- **Verity Central Technical Reference Manual:** Updated for **Verity Voting 2.3**
- **Verity Count Technical Reference Manual:** Updated for **Verity Voting 2.3**
- **Verity Service and Maintenance Operations Technical Reference Manual:** Updated for **Verity Voting 2.3**

5.2.1 Evaluation of TDP

The Technical Data Package for the **Hart Verity Voting 2.3** voting system was found to comply with the standards. A jurisdiction would be able to deploy the **Hart Verity Voting 2.3** voting system using the TDP.

5.3 Hardware Testing

Hardware testing was performed on **Verity Scan** and **Verity Controller/Touch Writer Duo**. Each device was subjected to: Electrical Power Disturbance, Electrical Fast Transient, Lightning Surge, Electrostatic Disruption, Electromagnetic Emissions, Electromagnetic Susceptibility, Conducted RF Immunity, Magnetic Fields Immunity, Bench Handling, Vibration, Low Temperature, High Temperature Test, Humidity Test, Temperature and Power Variation and Maintainability testing. Both devices successfully completed hardware testing.



5.4 Functional Testing Summary

Functionality was tested as identified below for the **Verity Voting 2.3** system.

5.4.1 Test Suites Utilized

The following test suites were executed:

Verity Data/Build test suite – The **Verity Data/Build** component was re-tested in depth in order to verify that the modifications implemented, and the subsequent Trusted Build of the software, did not adversely affect operations within this application. This testing was completed without issue.

Verity Desktop test suite – The **Verity Desktop** component was re-tested in depth in order to verify that the modifications implemented, and the subsequent Trusted Build of the software, did not adversely affect operations within this application. This testing was completed without issue.

Verity User Management test suite – The **Verity User Management** component was re-tested in depth in order to verify that the modifications implemented, and the subsequent Trusted Build of the software, did not adversely affect operations within this application. This testing was completed without issue.

Verity Touch Writer test suite – The **Verity Touch Writer** component was re-tested in depth in order to verify that the modifications implemented, and the subsequent Trusted Build of the firmware, did not adversely affect operations within this application. This testing was completed without issue.

Verity Touch Writer Duo test suite – The **Verity Touch Writer Duo** component was tested in depth in order to verify that the modifications implemented, and the subsequent Trusted Build of the firmware, did not adversely affect operations within this application. This testing was completed without issue. Note that basic functionality of this device mirrors that of **Verity Touch Writer**.

Verity Touch test suite – The **Verity Touch** component was re-tested in depth in order to verify that the modifications implemented, and the subsequent Trusted Build of the firmware, did not adversely affect operations within this application. This testing was completed without issue.

Verity Print test suite – The **Verity Print** component was re-tested in depth in order to verify that the modifications implemented, and the subsequent Trusted Build of the firmware, did not adversely affect operations within this application. This testing was completed without issue.

Verity Scan test suite – The **Verity Scan** component was re-tested in depth in order to verify that the modifications implemented, and the subsequent Trusted Build of the firmware, did not adversely affect operations within this application. This testing was completed without issue.

Verity Central test suite – The **Verity Central** application component was re-tested in depth in order to verify that the modifications implemented, and the subsequent Trusted Build of the software, did not adversely affect operations within this application. This testing was completed without issue.



Verity Count test suite – The **Verity Count** application component was re-tested in depth in order to verify that the modifications implemented, and the subsequent Trusted Build of the software, did not adversely affect operations within this application. This testing was completed without issue.

Modifications test suite – The **Modification** test suite explicitly examined each modification introduced into **Verity Voting 2.3** in order to verify that the modifications implemented, and the subsequent Trusted Build of the firmware, did not adversely affect operations. This testing was completed without issue

General Election test suite – The full **Verity Voting 2.3** voting system was reviewed in order to verify continued integration of the voting system and that all components continue to work as expected. This test was completed without issue.

Closed Primary Election test suite – The full **Verity Voting 2.3** voting system was reviewed in order to verify continued integration of the voting system and that all components continue to work as expected. This test was completed without issue.

Open Primary Election test suite – The full **Verity Voting 2.3** voting system was reviewed in order to verify continued integration of the voting system and that all components continue to work as expected. This test was completed without issue.

Language test suite – Testing was conducted to ensure the voting system is capable of presenting the ballot, ballot selections, review screens and instructions in the required languages. The system's ability to handle the prescribed foreign languages that have been declared to be supported, English, Spanish, Chinese, Japanese, Korean, Khmer, Thai, Vietnamese, Tagalog, Ilocano, and Hindi were validated. This test was completed without issue.

Accuracy test suite – **Verity Scan** was tested for accuracy of ballot marks reading in association with updated hardware. **Verity Central** was also tested to verify ability to read 8.5"x20" ballots accurately. This test was completed without issue.

Volume test suite – The full **Verity Voting 2.3** voting system was reviewed in order to verify compliance with the updated stated system limits. This test was completed without issue.

Stress test suite - The full **Verity Voting 2.3** voting system was reviewed in order to verify appropriate responses. This test was completed without issue.

5.5 Evaluation of Testing

The above tests were successfully conducted using the executables created in the Trusted Build, in association with the appropriate hardware versions as declared in this Test Report for the **Hart Verity Voting 2.3** voting system.

5.6 Quality Assurance and Configuration Management Audits

The review process verified that the manufacturer has written processes and procedures for Quality Assurance and Configuration Management. The processes and procedures were implemented within the software development life cycle used to produce the **Hart Verity Voting 2.3** system.



Coverage of tests employed by **Hart** was deemed satisfactory for meeting the requirements of the VVSG 1.0, as well as Hart internal requirements for state specific feature implementations. The CM portion of the review focused on the organization's understanding and implementation of the declared configuration management processes, procedures and policies. Deliverables were reviewed against all pertinent CM processes employed by **Hart**. Implementation of the **Hart** configuration processes was adequately documented and followed throughout the course of the **Verity Voting 2.3** project, and no issues were encountered.

5.7 Discrepancies Found During Testing

Discrepancies found fall into 4 major categories, Hardware, Documentation, Source Code, and Functional.

Hardware discrepancies are issues that occur specifically in the hardware arena, and are usually found during the hardware testing phase.

Documentation discrepancies are issues that occur during the PCA documentation (TDP) review phase and are issues that are resolved by updates to the documentation.

Source Code discrepancies are issues that occur during source code review and are issues that must be fixed in the source code prior to the Trusted Build.

Functional discrepancies are issues that occur during functional testing and can be related to any software or firmware within the system. Functional discrepancies often lead to source code modifications, additional source code review and an additional Trusted Build.

5.7.1 Documentation Discrepancies

Twenty-nine documentation discrepancies were written during this campaign, all were satisfactorily resolved

5.7.2 Source Code Discrepancies

Six source code discrepancies were written during this campaign, all were satisfactorily resolved.

5.7.3 Hardware Discrepancies

Four hardware discrepancies were written during this campaign, all were satisfactorily resolved.

- Verity Scan Failed ESD Causing Display Screen to Freeze
 - Resolved by:
 - Debug/Development components that were inadvertently left on the assembly were removed. These components serve no purpose in the product functionality and were present only for the development portion of the project.
 - Shielding of sensitive signals on the PCB was implemented through additional metal shields and conductive metal shielding tape.
 - Insulating the LCD metal frame from the seam between the LCD and the plastic enclosure.

- Verity Controller / TW Duo Failed ESD Causing Display Screen to Freeze



- Resolved by:
 - Debug/Development components that were inadvertently left on the assembly were removed. These components serve no purpose in the product functionality and were present only for the development portion of the project.
 - Shielding of sensitive signals on the PCB was implemented through additional metal shields and conductive metal shielding tape.
 - Insulating the LCD metal frame from the seam between the LCD and the plastic enclosure.
- Verity Scan Failed ESD, Scanner Diag Test Utility Lost Connection
 - Resolved by:
 - The test utility provided the scanning function for automation purposes during ESD testing. When the utility lost connection, it was able to be restarted. ESD testing was completed successfully with the anomaly noted, and all other applications and functions on the Verity Scan continued to operate without disruption. For future endeavors, however, Hart will develop an automated test utility in order to remove this occurrence.
- Verity Scan S1801828110 Fail Temperature and Power Variation Tests
 - Resolved by:
 - The scanner mechanism was determined to be part of an initial production run of the PageScan V scanner mechanism, in which the MSD boards were hand soldered. The less precise hand soldering method resulted in a cold solder joint on the MSD board, causing it to lose communication and cause the anomaly. All MSD boards after the initial production run are manufactured with a uniform and automated wave soldering process.

5.7.4 Functional Discrepancies

Four functional discrepancies were encountered during this campaign, all were satisfactorily resolved.

- In Data, Help incorrectly describes Add Party Selection
 - The Help menu now accurately describes the button that is available to the user. The "Add Party Selector" button is described as, "Click the Add Party Selector button to add a straight party selection contest."
- In Controller & Duo, Robustness Error does not accurately describe device
 - The warning message now displays the following: "WARNING: A **device** with an active voting session was disconnected and never reconnected. There may be a stranded ballot or unreported session on that device. This situation can be resolved by reconnecting the device while polls are still open.
The polls cannot be reopened once they are closed."
- In Controller, Reset Booth numbering Incorrectly describes device
 - The controller screen was updated to no longer display the 'Touch' device and now states, "If you reset your booth numbers, you will need to reassign a booth number to each connected device before voting can continue. "



- In Controller, Incorrectly Displayed ballot Cast on Message
 - The controller now allows the user to deactivate an access code that has not been used.

6 Recommendations

SLI has successfully completed the testing of the **Hart Verity Voting 2.3** voting system. It has been determined that the **Verity Voting 2.3** voting system meets the required acceptance criteria of the Election Assistance Commission Voluntary Voting System Guidelines 1.0 (2005).

It is SLI's recommendation that the EAC grant certification of **Hart Verity Voting 2.3** voting system. This recommendation reflects the opinion of SLI Compliance based on the testing scope and results.

SLI:

A handwritten signature in blue ink, appearing to read 'Traci Mapps'.

Traci Mapps

Director

February 26th, 2019